

# Dewey Burdock Class 3 and Class 5 Injection Wells - Public Testimony

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## General Considerations of Permits for Class 5 and Class 3 mining wells for Dewey Burdock

- EPA should require thorough borehole identification and plugging prior to issuing a permit, as there are currently 7,650 old boreholes that have not been closed or have been closed incorrectly (ie. with fence posts, or pie plates with a rock on top).
- EPA should require the additional pump tests that will be necessary (the existing data is admittedly incomplete) – NRC is requiring these tests prior to operations – EPA should hold the same requirement prior to full permitting under UIC (EPA should not be pressured to permit this project in order to obtain the necessary data on its environmental safety parameters).
- This would be the first EPA-led Class 3 UIC permit ever issued for ISL mining. At the start of the Powertech application process, EPA met with Powertech representatives and worked to define key terms of the regulations without any involvement by Native American Tribes nor the public. We feel this was wrong and we ask for the EPA to begin developing a formal and standardized Class 3 UIC permitting process.

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- If the the Class 3 permit is approved, the EPA should include a detailed analysis of current leaking abandoned mine impacts on groundwater, as well as locating and proper reclamation of all the open boreholes to repair the previously damaged confining layers, as the NRC has done.
- There is no description of the kind of wastes that might be injected in the Class 5 injection wells, nor toxic metals, so that correct monitoring for potential contamination of downstream private wells could be done. Currently, no documentation is required for incoming wastes, from other areas or countries, destined for the deep injection wells. This needs to be done as all of Powertech's wastewater will contain heavy metals, including unrecoverable organified uranium and other unrecoverable and un-filterable toxic and heavy metals, along with radioactive metals. Powertech's waste water does not qualify as non-hazardous. If it could be considered non-hazardous, then it would most certainly be used for agriculture or other purposes in this semi-arid climate (where clean water is always in demand). The "airing out" of radon from the waste water via evaporation ponds should not qualify as a corrective treatment for Class 1 radioactive and heavy metal waste into Class 5 deep injection wells. The lack of information in the Powertech application, with so many blanks to be filled in later, says to oversight regulatory agencies "Just give us the permit and we will fill in the blanks later", which was also advised by the corrupt DENR, of whom, who many are stock holders in Powertech. EPA should be where this buck stops.
- Additionally, Powertech did its measurement of groundwater flow from East to West (from Dewey-Burdock to Dewey-Burdock Terrace on the Wyoming side of the Black Hills) while the water, according to USGS maps, actually flows from West to East. Powertech and the state of South Dakota seem to entirely disagree with hydrological flows in the application area. EPA should require Powertech to do the correct water flow analysis, from West to East as the correct direction of water flow, and to monitor plumes from the Class 5 wells. <https://pubs.usgs.gov/wri/wri024094/pdf/wri024094.pdf>

## **General History of the Powertech Company and Current Status of Their Mining Permit from NRC.**

In the 1970's and 1980's, the Dewey Burdock area was, yet again, thoroughly investigated for potentially mineable uranium deposits, after the open pit mining of the roll front was completed in the 1960's. Uranium yellowcake was then going for \$100 / lb and in high demand. The Tennessee Valley Authority was hired by the US DOE to locate geological sources for uranium. TVA then drilled over 7650 test site

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boreholes in Edgemont, in two investigative sessions, to locate more recoverable uranium during/for the Cold War. A test mining tunnel was even attempted, but caved in due to the extensive and volatile cave structures in the area. They even lost an excavator, it sunk right into the ground while parked in what they thought was a safe place, in the open air. The TVA abandoned the site altogether, twice, concluding that there was not enough recoverable uranium to warrant a mining project. Powertech tried to mislead the public by including focus on uranium levels tested in alluvial wells - instead of limiting tests to the proposed affected aquifers. The alluvial wells actually showed higher levels of uranium than the intended mined aquifers, which actually confirms the TVA's conclusion that the roll front uranium deposits were gone. Powertech was falsely trying to claim the alluvial deposit concentrations as part of the deposits they would be mining. Alluvial wells are not mineable as they cannot be confined, composed mostly of surface water.

Like many mining companies in Canada, where the laws are lax, Powertech was formed by a hedge fund in Vancouver about 1990, that has absolutely no experience or history in mining of any kind. They intended Powertech as an investment vehicle.

The ten people who had shares in Powertech began to manipulate the reports about the company in order to raise the stock share price. They first operated out of Colorado, attempting to start a uranium mining operation there. They drilled some test holes and damaged local water supplies. They were immediately sued by angry local home owners. The lawsuits ended up at the supreme court level of Colorado, where they lost. The governor of Colorado and the legislature passed some restrictive mining laws and virtually forced Powertech out of Colorado. For this history, please consult [powertechexposed.com](http://powertechexposed.com).

Powertech then showed up in South Dakota, where they induced the legislature to pass SB 158 in 2011, which negated all of the uranium mining controls that we had in South Dakota at the time. A substantial number of legislators, state officials, Fall River County officials, and prominent people in South Dakota were induced to buy the stock at \$20 per share, with promises that the stock would be expected to go to \$600. per share. Over the years, 420 million shares of stock were issued and \$68 million were run through this small company, sold worldwide on the Toronto Stock Exchange. Sole revenues for Powertech were and still are, stock sales, with promising sounding "forward looking" press reports, while attempting to get various mining permits. They were granted a conditional NRC permit, but have never been able to use it because they have never complied with the conditions for use. Currently that permit is on hold indefinitely from NRC. There are two more permits needed from the state of South Dakota, requiring a mining permit public hearing and a water use permit public hearing, that are tabled pending the NRC and the EPA rulings.

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The TVA documents attached show that the Fuson shale is a leaky aquitard and the main reason that ISL mining was not considered at Dewey Burdock, causing the TVA to abandon the site after 10 years and 2 explorations. This was never a viable site to mine uranium from the beginning.

This company is inexperienced in mining, grossly underfunded, and nearly bankrupt, with stock prices currently in the 2 cents per share range. Historical investors have all lost their money.

### **The Science Against Injection Wells in this Proposed Area (Dr. LaGarry and Dr. Moran)**

Testimony of Dr. Hannan LaGarry, geologist stratigrapher, to NRC and ASLB 2014, shows that there are extensive fractures, fissures, sinkholes and breccia pipes in the area that dramatically increase permeability within confinement layers. These geological features go unrecognized by Powertech.

Powertech was “cherrypicking data” (selecting a non-representative sample to incorrectly represent the whole) from the first TVA exploration in the 1950’s and 60’s, carefully selecting only the data that supported their project. They were not even in possession of the latest exploration TVA data from the 1970’s and 80’s when they submitted their permit requests. Powertech just obtained those documents in May of 2014. In the discovery of that data in the NRC/ASLB hearing of 2014, Dr LaGarry found that the drillers logs, notes and hydrological pump tests “did not provide a scientifically recognized analysis that can support any hydrogeological conclusion about the project area”. He also concluded that “The NRC ‘spot check’ of 37 random data points does not provide a statistically reliable testimony or basis for any conclusions regarding confinement or hydrology.”

Dr. LaGarry also added “NRC Staff presents no basis for its so-called “random” selection. Without such information, professionals in my field cannot accept such assertions where it is possible that the limited data set resulted in poor methodology that is the hallmark of modern junk science. Having examined only 37 data points out of thousands available, NRC would have failed my Math 123 Introduction to Statistics class. None of my student researchers would be allowed to publish or present their research findings had they made such a fundamental error.”

Dr. Robert Moran’s, hydrologist, testimony before NRC/ASLB thoroughly established that, “Dewey-Burdock uranium ore zones are not hydraulically - isolated from other geologic units, other aquifers, or zones outside the project area.” He provides many

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examples of what he refers to as, “NRC Staff disregarding the conclusions of numerous hydrogeologic experts (both Powertech-funded and independent).

## **The Quantity of Injection Wells Requested for Waste is Ridiculous**

Powertech/Azarga is asking for 4 Class 5 UIC deep injection wells for hazardous waste deposition, into the Minnelusa aquifer, with a reserve request for 4 more of the same “in case they find the they need them”. They say they need 2 of these “right away”. Powertech/Azarga will operate 14 well fields total. The Minnelusa aquifer is a major drinking water aquifer in the Black Hills. To say that it is not, is not correct.

For comparison, Crow Butte ISL uranium mine in Crawford, Nebraska, operated 11 well fields for 20 yrs using a single UIC hazardous waste deep injection well for deposition of their toxic wastes. Dewey Burdock originally requested a total of 8 UIC hazardous waste deep injection wells, but EPA is only permitting 4, still too many for a non functional, no profit mine, two of which are requested to be drilled right away. (Really? What do they need them all for? No work has been done to find and properly close any of the old borehole sites that is required by NRC, followed by adequate pump testing to make sure that the aquifer is contained prior to actively mining. EPA is not requiring borehole closure for the injection wells. This spells certain “disaster” even more.) It is estimated that this work will take approx. 3 years before any mining can take place.

By the numbers: Smith Ranch in WY :10 well fields, one deep injection well Crow Butte, Ne : 11 well fields, one deep injection well for 20 yrs. Willow Creek, composed of two sites, Christensen Ranch and Irigary- 2 injection wells.

Powertech/Azarga has also applied for Class 3 injection wells for 14 well fields. This will be an additional 84 injection wells that will be receiving rock dissolving chemicals/lixivients for production. Normally a well field contains one production well for extraction surrounded by 6 injection wells. Further, the 14 production well fields are not on a uranium rich roll front, as per TVA documents. (uranium ISL mines are typically situated on a uranium rich roll front so that extraction is efficient and the mine is profitable. Remember, the roll front was found by TVA to be mined out prior by surface mining) Where did the increased number of wells come from up to 4,000?

The 4 hazardous waste deep injection wells in the area are destined for the Minnelusa aquifer, a drinking water aquifer in the Black Hills. Normally, UIC hazardous waste deep injection wells are drilled “below” aquifers, not “in” them. The hazardous waste injected into the aquifer will travel hundreds and even thousands of

miles and contaminate other aquifers that are connected, and ultimately the huge Ogallala Aquifer that services the entire central US. In addition, these hazardous waste wells will legally be able to take in the water of the hazardous wastes, containing radioactives, with toxic and heavy metals from other mining sites, to make our aquifers a toxic waste dump, and ruin the water we have there. Since the wastewater will contain radioactives and toxic heavy metals, the ultimate destination as to which class of deposition well is required, is determined by the proximity of the drinking water aquifer near it, above or below. Powertech /Azarga has played a semantics game with the determination of the class of disposal well required, however the toxicity of the ultimate wastewater is still the same. Nowhere can I find where Class 1 waste waters were ultimately dumped into a class 5 injection well.

The claim that Powertech/Azarga is going to treat the wastewater first to “purify” it to classify for the Class 5 deep injection regulations, does not include the inability to extract radioactive organified metals that are now found in wastewater by ISL in several studies, notably uranium. By regulation, Class 5 waste waters can only be as toxic as storm sewer waters. This wastewater is hardly that. Radioactive organified metals and metallic salts in this wastewater make this waste water unusable for even agricultural purposes, as it would be in this dry uplift area where water is “blue gold”, if it were as “pure” as the company says it is. Better technology today shows us the flaws of obsolete testing and regulations today, and why we see such horrid toxicities in Nature at mining sites. The company has not shown any technology that could be effective in processing this wastewater to be safe for a Class 5 well. And the extra great expense of this processing will cost the profitability of the project dearly. They already cannot pay their mining land leases and are essentially bankrupt going in to this project.

## **Injection-Induced Earthquakes**

A July 2013 study by US Geological Survey scientist William Ellsworth links earthquakes to wastewater injection sites. In the four years from 2010-2013 the number of earthquakes of magnitude 3.0 or greater in the central and eastern United States increased dramatically. After decades of a steady earthquake rate (average of 21 events/year), activity increased starting in 2001 and peaked at 188 earthquakes in 2011. USGS scientists have found that at some locations the increase in seismicity coincides with the injection of wastewater in deep disposal wells. Injection-induced earthquakes are thought to be caused by pressure changes due to excess fluid injected deep below the surface and are being dubbed “man-made” earthquakes.

<http://people.uwec.edu/piercech/HazwasteWebsSp04/DeepWellInjection/DeepWellInjection.htm>

## References:

High-rate injection is associated with the increase in U.S. mid-continent seismicity

Barbara A. Bekins, and Justin L. Rubinstein Abstract An unprecedented increase in earthquakes in the U.S. mid-continent began ... in 2009. Many of these earthquakes have been documented as induced by wastewater injection. We examine the relationship between wastewater injection ... and U.S. mid-continent seismicity using a newly assembled injection well database for the central and eastern United States. We find that the entire ... increase in earthquake rate is associated with fluid injection wells. High-rate injection wells (>300,000 barrels per month) are much more likely to be ...

## Induced Earthquakes

The primary cause of the recent increase in earthquakes in the central United States. Wastewater disposal wells typically operate for longer durations and ... injection wells induce earthquakes. Most injection wells are not associated with felt earthquakes. A combination of many factors is necessary for injection to ... induce felt earthquakes. These include: the injection rate and total volume injected; the presence of faults that are large enough to produce felt ... earthquakes; stresses that are large enough to produce earthquakes; and the presence of pathways for the fluid pressure to travel from the injection ...

## Injection-induced earthquakes

Abstract Earthquakes in unusual locations have become an important topic of discussion in both North America and Europe, owing to the concern that ... and underground mining, withdrawal of fluids and gas from the subsurface, and injection of fluids into underground formations. Injection-induced ... production of oil and gas from previously unproductive formations. Earthquakes can be induced as part of the process to stimulate the production from tight ... associated with industrial activity, with a focus on the disposal of wastewater by injection in deep wells; assess the scientific understanding of induced ...

## A Century of Induced Earthquakes in Oklahoma?

related to oil production, particularly disposal of wastewater in deep injection wells, are known to potentially cause earthquakes. Prior to the ... Release Date: October 26, 2015The rate of earthquakes has increased sharply since 2009 in the central and eastern United States, with growing ... evidence confirming that these earthquakes are primarily caused by human activity, namely the injection of wastewater in deep disposal wells. The rate of ... earthquakes has increased sharply since 2009 in the central and eastern United States, with growing evidence confirming that these earthquakes are ...

## Sharp increase in central Oklahoma seismicity 2009-2014 induced by massive wastewater injection

data required to unequivocally link earthquakes to injection are rarely accessible. Here we use seismicity and hydro-geological models to show that ... earthquakes to distances of 35 km, with a triggering threshold of  $\sim 0.07$  MPa. Although thousands of disposal wells may operate aseismically, four of ... Sharp increase in central Oklahoma seismicity 2009-2014 induced by massive wastewater injection Science By: Kathleen, M. Keranen, Geoffrey A. Abers ... , Matthew Weingarten, Barbara A. Bekins, and Shemin Ge

### **The Proximity of Igloo, Black Hills Army Depot/Black Hills Ordnance Depot**

- The Black Hills Ordnance Depot was officially designated in February 1942 in Fall River County. The site consisted of 21,095.85 acres, and was utilized for long-term storage of ammunition. In August 1962, the site was renamed the Black Hills Army Depot. The facility was developed with industrial storage, administrative buildings, housing, and related support facilities and utilities. The Depot was used for the receipt, storage, maintenance, inspection, testing, restoration, issuance and shipping of ammunition, propellants, and chemical toxics, the unpacking and functional packing of small arms ammunition, and the demilitarization of unsafe, obsolete and surplus ammunition, chemical ammunition, ammunition components, chemical toxics and general supplies. On June 30, 1967, the Black Hills Army Depot was closed and in 1968 was declared surplus by the Department of the Army. The City of Edgemont, South Dakota, purchased all land within the boundary fence and the remainder of the former site was transferred to the United States Forest Service. Currently, the entire site is used for livestock grazing. In 1981 a study conducted by Ecology and Environment, Inc. determined that a change in land use which would generate direct human contact, such as housing or crops for human consumption, should be avoided.
- 368,000 tons of various kinds of nerve gas is stored underground and dumped in 200 miles of trenches on the 21,000 acre site. BHAD contaminants are: Sarin, Soman, Toban, GB, VX, Lewisite, Mustard Gas. Phosgene, as well as a host of very lethal things recovered from Germany at close of WWII. These canisters were soaked in ice water overnight so they could be opened, and a stabilizer added that would stabilize for just 10 to 15 years, according to the files, but that was back in the 1950's. Obviously, these nerve gases, which are both oil and water soluble in now unstable canisters should not be disturbed by pressurized injections known to cause earthquakes, or with remainder corrosive lixivients that



would harm the fragile canisters. at least some of the old boreholes were described by the TVA were directly into the tunnel structures.

- Additionally, great numbers of UOX/ unexploded ordinance including rockets, hand grenades, bombs, land mines etc., are also buried there. The combination of these UOX and the toxic nerve gasses together spells something like an Armageddon if the site were disturbed by anything at all that would have even the remotest possibility of releasing this monster of a mess.
- Sandia Labs has several reports on the dangers of chemical warfare agent bombs using M-55 rockets that are destabilizing and auto igniting. Too dangerous to move. Studies of this problem were commissioned by Congress. Circa 1994. Here is a link to the complete report <https://www.nrc.gov/docs/ML1305/ML13053A145.pdf>
- US Senators Larry Pressler and Tom Daschle both received classified briefings by the Pentagon on the dangers of the BHAD. Both are living in the Washington DC area.
- When one considers that the Wind Cave Structure lies beneath the depot, one comes to the inescapable conclusion that we should never disturb this area with any mining activity or injection wells. The Wind Cave Structure is huge and not even fully explored or mapped.
- There have been leaks documented in the are already, ranchers have sustained episodes of livestock deaths and wildlife deaths in the depot area from time to time. A rancher who owned a creek on the east side of the depot lost 1200 sheep in a four day period one spring.
- The 4,000 foot Madison well at Igloo is already showing increased levels of arsenic, radioactivity and other heavy metals. Since the U.S. Army insists that the Black Hills Army Depot was not a nuclear or atomic site, I feel that the increased levels of heavy radioactive metals and arsenic are from the older uranium mines in the area from the 1950s has begun to enter the aquifer.
- If we disturb the area with injection wells, bore holes etc., and force toxic sludge under pressure into the underground areas riddled with the massive Wind Cave structure, we will get the BHAD contaminants moving in the plume. These are soluble in oil and water. Deep injection wells will unleash a catastrophic moving lethal torrent underground that will kill everything it touches, borne by oil and water wells. That plume will flow directly towards the city of Hot Springs, poisoning the local Minnelusa wells, of which 22 on the west side are now under

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monitor for possible class action suites.

- The plume will also contaminate the municipal water of that city which is a mixture of all the aquifers, according to the water engineer of Hot Springs, and Evans Plunge - the 100 yr old natural hot springs swimming pool that is a local and tourist attraction. The state shows anywhere from over 100 to a possible 1000 Minnelusa wells in the Hot Springs area and Fall River County, where the plume will flow, and possibly to Custer County as well. The state of SD only began keeping records of wells in the recent past, so there are many undocumented domestic wells where people do not even know what aquifer their wells are in or how deep they are. They will not know that they are drinking hazardous waste until their cattle all die and they get cancer. Poisoning a whole city and county should be fresh on the minds of the EPA from the Flint, Michigan fiasco, my home town.
- The 22 domestic wells recently tested all showed very low uranium levels and low to very treatable TDS, and all families but one were drinking the water, with only one using a softener and several just a sediment filter. Nobody was using an RO.
- If the TDS elevates, the water will not be treatable and will contain high levels of organified uranium from the wastewater plume, an obvious tracer to the deep injection wells, since a baseline has now been established. Powertech/Azarga and the EPA will be the targets of a massive lawsuit, with the mining co undoubtedly filing bankruptcy, as they are known to do, and leaving EPA holding the bag for monetary claims.
- The wastewater from Dewey Burdock mines will undoubtedly contain an even higher level of organified and unrecoverable uranium than that already documented from other ISL mine sites, because of the open boreholes contaminating the aquifers with micro organisms that are known to organify metals. Other organified toxic metals will also be elevated, increasing the toxicity of such by increased bioavailability and biochemistry in the living body.

### **Basis for My Testimony as Expert in Field**

As an environmental biochemist working with toxic exposures in both animals and humans for the last 40 years. I was born and raised in Flint, Michigan, lived there for the first 55 years of my life with over 450 Class 7 industrial dumpsites in each of the counties in SW Michigan. So I am well acquainted with environmental contamination of all kinds. This is the reason, actually, that I sought my course of study, and pursued a

career in the effects of environmental pollution on the living body of both humans and animals. I am also a federally approved expert witness.

I have collected the largest databank for hair analysis monitoring of metals and minerals of anyone in the world since 1977. This databank follows the continuing increase in environmental toxins in air, water and food residues over the last 50 years, and correlates with disease and health compromise symptoms and syndromes. To date, I have one Canadian and 7 U.S Patents for products and protocols addressing health compromises from environmentally driven diseases in both humans and animals, including one for the only diet protocol that has ever earned a U.S Patent. This diet program resulted from my research from the 1970's, 1980's and 1990's, and underlies all the popular and effective diets of today featuring low carbohydrate, high protein, and high monounsaturated healthy vegetable oils, including the Atkins Diet, the South Beach Diet, the Zone Diet, the American Diabetes Association Diet, the Mediterranean Diet, etc. The foundation of this revolutionary approach is designed to fuel biochemical energy pathways while supporting compromised biochemical pathways, including hormone pathways, and also addressing detox of the interfering environmental chemicals, so that normalization of biochemistry is achieved. I have served in Michigan as an expert witness in state courts in environmental pollution and dumping cases and as expert witness in South Dakota in state and federal (NRC) hearings in the Dewey Burdock case for ISL uranium mining.

## **The Non Radiological Effects of Uranium**

Inorganic forms of minerals, especially selenium and uranium, as well as other heavy metals, which consistently test high in aquifers post mining, have shown to be toxic to living systems of plants, animals and humans in very low levels. Uranium toxicity at low levels has shown in population statistics of exposed population such as Native Americans on contaminated and exposed reservations downwind and downriver from old exposed uranium mines to be more predisposed to chronic conditions such as: metabolic syndromes, diabetes, behavior and sleep problems, obesity and heart disease, fertility, and morbidity and mortality compromises. These are non radiological effects of uranium discussed, in that uranium as a metal actively incorporates itself into the biochemistry of the body. The radiological effects are another subject, not involving the actual chemical reactions such are described here.

Reference:

**Heavy metal uranium affects the brain cholinergic system in rat following sub-chronic and chronic exposure**

“Previous studies have shown that uranium is present in the brain and alters behavior, notably locomotor activity, sensorimotor ability, sleep/wake cycle and the memory process, but also metabolism of neurotransmitters. The cholinergic system mediates many cognitive systems, including those disturbed after chronic exposure to uranium i.e., spatial memory, sleep/wake cycle and locomotor activity.”

<https://www.ncbi.nlm.nih.gov/pubmed/19409444>

**Uranium is known to travel through the blood to virtually every tissue and organ system in the living body through active transport by blood.** It will reduce and for solid precipitates in the hard tissues of the body like bone and also cause kidney stones and kidney disease and the precipitates enlarge with time and chronic exposure. Binding with bicarbonate in the body will also compromise the body's ability to neutralize acids, predisposing to gastric ulcers as well as various muscle pains, cramps and spasms. Highly acidic bodies with compromised acid neutralization abilities, such as contamination with compromising uranium ions, will have higher agitation levels and volatility of behavior. Uranium ions in the liver will compromise blood sugar regulation, causing increased cravings for sugars in the diet, leading to diabetes, metabolic syndromes and obesity, as carbohydrate metabolism is compromised. Further, as blood sugar lacks internal regulation, alcohol and drug use is elevated in statistics, as the body struggles to “just feel good for a little while”. Increased cancer rates are observed with uranium exposure as well as reproductive toxic effects with DNA breakage observed. Compromise to the connective tissues of the body, that cover virtually every surface in the entire body, produce autoimmune diseases such as crippling Lupus. This is exactly what we are seeing in population health statistics on the reservations affected. Further, the toxic effects of uranium are greatly enhanced in the presence of calcium ions, which are known to be generated in ISL mining as well as in runoff waters of the Rocky Mountains over old uranium open pit mines. The Rocky Mountains are high reservoir of calcium carbonate, so ISL mining waters containing uranium as they are known to do, will have even more toxic effects in synergy than what would be expected and predicted of each separately.

Reference:

**Medical Effects of Internal Contamination with Uranium**

Croatian Medical Journal v.40, n.1, Mar99 Asaf Duraković  
Department of Nuclear Medicine, Georgetown University School of Medicine,  
Washington D.C., USA

**“Uranium as a heavy metal is of particular importance as a complex of uranium and bicarbonate ions, which increases the solubility of uranium in serum. This compound is rather insoluble in water due to the complex ion formation between uranium and bicarbonates. This mechanism determines the**

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**transport of ultra filterable uranium from the sites of contamination to the tissues and target organs (8). In blood, the uranium-bicarbonate complex establishes an equilibrium with non-filterable protein-bound uranyl ions, with 60% of uranium bicarbonate-formed and 40% protein- formed (9). In other studies, 74% of uranium in blood was present in the inorganic compartment of plasma, 32% was protein-formed, whereas 20% was associated with red blood cells (10). Uranyl salt complexes with bicarbonates are less stable than uranous salt complexes. Reduction of uranium in plasma is not probable, while the uranous salts can be reduced in the intracellular environment (11). Uranous (IV) retention sites are the bone and kidney, whereas uranyl (VI) ions accumulate in the liver and spleen prior to their redistribution in the renal and skeletal system.”**

“Each of the uranyl ions are complexed by two phosphate ions on the surface of bone crystals, with simultaneous release of two calcium ions. The uranous ion produces a toxic effect on the living cells by inhibiting the processes of metabolism of carbohydrates by the inhibition enzyme systems. A uranyl ion replacing a magnesium ion binds the ATP molecule to hexokinase. ATP-uranyl-hexokinase complex blocks the release of phosphate to glucose, inhibiting its first step of metabolic utilization with non-metabolized glucose in the extracellular environment (12). The toxic effects of uranium were shown to be enhanced by the administration of calcium (33). The effects of uranium on the nervous system have been described as paralysis of the hind legs, blindness, and loss of coordination in rabbits in the terminal phase of intoxication (52). Most recent studies indicate significantly higher prevalence of malignant diseases in uranium workers (59), with increased mutations in underground miners (60) and connective tissue disease, including lupus erythematosus (61). Reproductive toxicity of uranium in a recent Chinese study includes chromosome aberrations in spermatogonia, causing DNA alterations in the spermatocytes and strand breakage in sperm (62).”

**All metals/minerals have a relationship to each other in Nature.** They balance each other. Too much of one will have a negative effect on the other. For good health, they all need to be in proper balance. Heavy metals generated from mining are many, and will compromise many essential minerals for health. When one mineral or metal is too high, it will exert a repressive effect upon its counterpart metal or mineral, causing a deficiency or imbalance. Since minerals are known to fuel enzyme systems in the body, and the living body is dependent upon enzymes for life itself, compromise of any enzyme system can cause severe health consequences and even death. The toxic heavy metals generated in ISL mining are shown in an overlay to accurately depict the interference of those toxins on the natural system and their impact to all living things, even plants. See slides 1-3

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Inorganic salts of metals most prominent in aquifers, also have different toxicities, and any monitoring of aquifers should include speciations of these different forms so that proper toxicity evaluation can be done. Simply giving the absolute levels of a metal does not tell the whole story. All metallic “salts” are not equal. They can have different solubilities, different melting points, different Ph, different conductivity affecting the central nervous system that relies on electrical signals, and totally different chemistry within the living body. Further, any discussion to the general lay public needs to distinguish between a chemical metallic salt and ordinary table salt, that the public is led to believe will be created as “salt” in a mined aquifer. Slide 4 shows the many species/ chemical forms that a metal can take upon exposure to oxidation/reduction reactions typical within an ISL mining aquifer. Typically, speciation testing, even if monitored by the mining company, is not made available to the public. Selenium is the example, but all metals do this.

### **The difference between inorganic and organic compounds:**

Organic compounds always contain carbon, while most inorganic compounds do not contain carbon. Also, almost all organic compounds contain carbon-hydrogen or C-H bonds. Organic chemistry is “The Chemistry of Life”. Metals in an inorganic form have significantly different chemistry in the living body from organically bound minerals. Organic forms of uranium as well as other toxic metals have also been shown to exist in mining areas and they are not known to be recoverable by the ion exchange method of ISL recovery, since it is already bound organically and will not bind to the organic synthetic resins. Organic forms of any heavy metal are known to be much more toxic and much more bioavailable, so that they are able to penetrate the lining of the digestive tract much easier than ionic and inorganic salts that are blocked by their electrical charges. Organic metals have their electrical charges spread over the organic ligand they are bound to, so that they act as a “chelate”, something that the health industry does to minerals to significantly improve absorption of essential minerals, and also make them much more able to enter into direct biochemical reactions in the living body. Organically bound metals under this circumstance, and there is plenty of organic carbon naturally existing with ISL mining sites to make this a complication, will continue to increase in the waste water of the ISL mine as they are **not recoverable, adding to the metal burden of the wastewater and also the toxicity of such beyond what would be if the metals remained in an inorganic and ionic form.**

Reference:

### **Problems with Ion Exchange in Water Purification**

“Ion exchange is another method used successfully in the industry for the removal of heavy metals from effluent. An ion exchanger is a solid capable of exchanging either cations or anions from the surrounding materials. **Commonly used matrices for**

ion exchange are synthetic organic ion exchange resins. The disadvantage of this method is that it cannot handle concentrated metal solution as the matrix gets easily fouled by organics and other solids in the wastewater. Moreover ion exchange is nonselective and is highly sensitive to the pH of the solution."

Arabian Journal of Chemistry

Volume 4, Issue 4, October 2011, Pages 361-377

(Kurniawan et al., 2006)

<http://www.sciencedirect.com/science/article/pii/S1878535210001334>

**On the other hand, binding natural essential minerals to organic molecules will make them more bioavailable as well, and so much better able to enter the living body.** We use that chelation process to enhance nutrition for essential minerals.

**25 controlled studies by different authors in five different countries adverse array of data is presented.** These data validate the effectiveness of mineral nutrients presented as amino acid chelates when compared with the ionic forms derived from the inorganic salts. These studies further support the results of numerous laboratory experiments showing increased absorption, assimilation and reduced toxicity of the forms of minerals chelated to amino acids. With little cost and effort animals can be supplemented with amino acid chelates which will promote, with little risk of overdose, a fuller genetic potential achievement as far as mineral requirements are concerned. Results of this supplementation are reflected in increased growth, immunological integrity and more consistent reproduction increased ovulation and conception after first service as a result of increased bioavailability of these. See slide 5

Reference:

**Chelated Minerals in Animal Nutrition**

Rajendran, C. Kathirvelan and V. Balakrishnan, Madras Veterinary College, Chennai, INDIA

[www.pitt.edu/~super7/32011-33001/32391.ppt](http://www.pitt.edu/~super7/32011-33001/32391.ppt)

**The Jeckyll and Hyde personalities of minerals**

Even the minerals that we consider necessary for the living body will have different biochemical actions and tissue and organ destinations in the living system. Common case in point: selenium. Selenium is known to have wonderful health effects, preventing cancer, converting the storage form of the storage thyroid hormone T4, to the active form T3 by virtue of fueling an enzyme glutathione peroxidase. This biochemical reactions is absolutely essential to life. Glutathione also doubles as the most powerful antioxidant in the body. Inorganic selenium, as is the form generated in ISL mining, is known to cause birth defects of the highest severity. However, in the inorganic state,

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selenium as a consequence of mining, is severely toxic, producing severe deformities. The higher evolved animals above micro organisms are not able to convert quantities of the inorganic forms of minerals, even essential ones like selenium, into the bio compatible organic forms.

**How inorganic metals are organified by microorganisms that contaminate aquifers from open boreholes, and surface waters and lands**

See slides 6 and 7

**Bioaccumulation of organified heavy metals rises quickly in the living systems and the environment, rising up the food chain.**

Elemental inorganic forms of metals and minerals are “organified”, bonded with carbon compounds to become organic forms by micro organisms, which are then eaten by simple life forms, which are then eaten by higher animals, and so on, all the way up to man and other top predators at the top of the food chain. As these metals and minerals pass from one body to the next, they are known to concentrate as they move up, with humans and other top predators then suffering the worst consequences from the highest concentration in their tissues and organs. There can be formed many different kinds of organic metal compounds, however, all are not equally bio essential, some are even more toxic as the living body cannot convert them. This will depend on which micro organisms are organifying the metals into which compounds.

See slides 8, 9 and 10

**Evidence for naturally occurring organified uranium has been found in significant levels in roll fronts.**

**Biogenic non-crystalline U(IV) revealed as major component in uranium ore deposits**

Amrita Bhattacharyya, Kate M. Campbell, Shelly D. Kelly, Yvonne Roebbert, Stefan Weyer, Rizlan Bernier-Latmani & Thomas Borch  
<http://www.nature.com/articles/ncomms15538>

SLAC Study Helps Explain Why Uranium Persists in Groundwater at Former Mining Sites

**New Details About Uranium Chemistry Show How It Binds to Organic Matter**

Article ID: 668799

Released: 2-Feb-2017 2:05 PM EST

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Source Newsroom: SLAC National Accelerator Laboratory

<http://www.newswise.com/articles/slac-study-helps-explain-why-uranium-persists-in-groundwater-at-former-mining-sites>

Newswise — Decades after a uranium mine is shuttered, the radioactive element can still persist in groundwater at the site, despite cleanup efforts.

A recent study led by scientists at the Department of Energy's SLAC National Accelerator Laboratory helps describe how the contaminant cycles through the environment at former uranium mining sites and why it can be difficult to remove. Contrary to assumptions that have been used for modeling uranium behavior, researchers found the contaminant binds to organic matter in sediments. The findings provide more accurate information for monitoring and remediation at the sites.

The results were published in the *Proceedings of the National Academy of Sciences*. In 2014, researchers at SLAC's Stanford Synchrotron Radiation Lightsource (SSRL) began collaborating with the DOE Office of Legacy Management, which handles contaminated sites associated with the legacy of DOE's nuclear energy and weapons production activities. Through projects associated with the Uranium Mill Tailings Radiation Control Act, the DOE remediated 22 sites in Colorado, Wyoming and New Mexico where uranium had been extracted and processed during the 1940s to 1970s.

Uranium was removed from the sites as part of the cleanup process, and the former mines and waste piles were capped more than two decades ago. Remaining uranium deep in the subsurface under the capped waste piles was expected to leave these sites due to natural groundwater flow. However, uranium has persisted at elevated levels in nearby groundwater much longer than predicted by scientific modeling.

In an earlier study, the SLAC team discovered that uranium accumulates in the low-oxygen sediments near one of the waste sites in the upper Colorado River basin. These deposits contain high levels of organic matter—such as plant debris and bacterial communities.

During this latest study, the researchers found the dominant form of uranium in the sediments, known as tetravalent uranium, binds to organic matter and clays in the sediments. This makes it more likely to persist at the sites. The result conflicted with current models used to predict movement and longevity of uranium in sediments, which assumed that it formed an insoluble mineral called uraninite.

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Different chemical forms of the element vary widely in how mobile they are—how readily they move around—in water, says Sharon Bone, lead author on the paper and a postdoctoral researcher at SSRL, a DOE Office of Science User Facility.

Since the uranium is bound to organic matter in sediments, it is immobile under certain conditions. Tetravalent uranium may become mobile when the water table drops and oxygen from the air enters spaces in the sediment that were formerly filled with water, particularly if the uranium is bound to organic matter in sediments rather than being stored in insoluble minerals.

“Either you want the uranium to be soluble and completely flushed out by the groundwater, or you just want the uranium to remain in the sediments and stay out of the groundwater,” Bone says. “But under fluctuating seasonal conditions, neither happens completely.”

This cycling in the aquifer may result in the persistent plumes of uranium contamination found in groundwater, something that wasn’t captured by earlier modeling efforts.

“For the most part, uranium contamination has only been looked at in very simple model systems in laboratories,” Bone says. “One big advancement is that we are now looking at uranium in its native environmental form in sediments. These dynamics are complicated, and this research will allow us to make field-relevant modeling predictions.”

The study combined the expertise of researchers at SLAC, Pacific Northwest National Laboratory and the Canadian Light Source. The research team used a blend of techniques to analyze samples of sediments in the experiment. They performed X-ray spectroscopy at SSRL to identify the chemical form of uranium. Capabilities at the Canadian Light Source and at the Environmental Molecular Science Laboratory (EMSL) at Pacific Northwest National Laboratory were used to map the locations of the elements in the samples at the nanometer scale. This additional information allowed the researchers to determine whether or not the uranium was bound to carbon-containing, or organic, materials. SSRL and EMSL are DOE Office of Science User Facilities.

The DOE Office of Science funded the project.

SLAC is a multi-program laboratory exploring frontier questions in photon science, astrophysics, particle physics and accelerator research. Located in Menlo Park, Calif., SLAC is operated by Stanford University for the U.S. Department of Energy's

Office of Science. For more information, please visit [slac.stanford.edu](http://slac.stanford.edu).

SLAC National Accelerator Laboratory is supported by the Office of Science of the U.S. Department of Energy. The Office of Science is the single largest supporter of basic research in the physical sciences in the United States, and is working to address some of the most pressing challenges of our time. For more information, please visit [science.energy.gov](http://science.energy.gov).

### See Original Study

[www.pnas.org/content/114/4/711.abstract](http://www.pnas.org/content/114/4/711.abstract)

**Selenium is a poorly regulated heavy metal, and difficult to regulate as far as toxicity and allowable levels are concerned, because of the myriad chemical forms that it can exist in, each with different toxicity.** The same can also be said for every other toxic metal as well as nutritional metal. The Jeekyll and Hyde personalities of these elements is a very real thing in the natural world. Slide 11 shows the incongruencies between actual toxicities of some chemical forms of selenium and the regulatory levels. Most toxicity level charts fail to take into consideration the chemical forms of metals and minerals, which is absolutely critical in assessing any toxicity status. Care for patients suffering from selenium poisoning is usually aimed at treating symptoms. There is no specific antidote or treatments for selenium poisoning.

Selenium from mining waste is highly mutagenic. Slides 12 through 19 show the mutations of selenium in old mining sites.

Reference:

### Upper Human Limits for All Minerals and Metals

<http://iom.edu/Activities/Nutrition/SummaryDRIs/~media/Files/Activity%20Files/Nutrition/DRIs/ULs%20for%20Vitamins%20and%20Elements.pdf>

**Arsenic is another major pollutant.** Unlike selenium, which has a value in certain chemical forms as a health and life biochemistry promoter, arsenic has not been found to have any health value outside of its use as a parasiticide, and even that use can have toxic consequences. Slide 20 shows the major health effects of arsenic exposure.

Arsenic, in particular, is extremely dangerous in the world today, and especially North America, because arsenic opposes iodine on the mineral wheel, meaning that high arsenic causes iodine deficiency. Current research has shown that we need far more iodine than we thought we did for health, and we are not getting it in food or water, even

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as we used to decades past, when iodine was used in food processing and water purification.

Arsenic has been rising in our environment and food supply because of the legal dumping of it into commercial fertilizers from mining and ore smelting waste since 1976 when it became legal to do so. In the 1980's President Reagan increased to legal limit of arsenic in public drinking water because the levels were rising so high, and arsenic is both difficult and expensive to remove from water, as mining reclamation efforts have shown.

Mother Nature, of course, does not necessarily agree that so much arsenic is safe! Arsenic compromises thyroid. Thyroid disease has escalated epidemically in the last 50 yrs since iodine was reduced in our food and water supplies. And today, as relevant for accelerated aging, each generation is not expected to live as long as its parents, and higher and higher statistics of formerly "old age" ailments are evident in younger and younger segments of the population, severely compromising our health care.

Arsenic ill cause a physiological iodine deficiency by its opposing actions even if there is enough iodine in the diet to counteract general deficiency. Such is the case with all opposing metals and minerals of nutritional minerals. This is how things work in Nature and the living body. Metals like arsenic have their own set of compromising chemistries, but the opposition and interference chemistries of opposing metals and minerals presents a whole new set of pathways for health compromise, independent of the individual roles of the individual metals in actual biochemical reactions. So, but its opposing action on iodine, arsenic can precipitate a whole hypothyroid overlay on the living body, complete with all the health compromises that a hypothyroid body will manifest. Slide 21 shows the different LD 50 doses for different chemical forms of arsenic. LD 50 represents the level at which 50% of the animals are killed from the toxin presented. So this again shows the importance of different toxicities of different chemical forms. Slide 22 shows the comparison of the toxicity of arsenic relative to other common toxins. Slides 23-27 show arsenic effects in humans.

There is no specific treatment for chronic arsenic poisoning. Once it has been identified further exposure should be avoided. Recovery from the signs and symptoms may take weeks to months from when exposure is stopped. In particular, effects on the nervous system may take months to resolve and in some cases a complete recovery is never achieved.

### **Epigenetics, a newly recognized toxic compromise of DNA by heavy metals.**

Epigenetics is a new study looking at how heavy metals and other environmental toxins can and do affect the gene expression of DNA to cause potentially serious ill health compromises, even death. DNA is actually a set of switches which are found to be

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controlled by chemical signals from the cell membrane of each cell, which are generated in response to the cell membrane's sensing of the environmental characteristics in the fluid surrounding it. Every living cell is actually floating in a body fluid called lymph. If the cell membrane senses that something is wrong, it sends a chemical signal to the cell nucleus and DNA there to adjust by turning on or off certain genetic switches. This is the living body's way of adapting to its surroundings for survival. This is evolution in progress.

Heavy metals have been found to both up regulate and down regulate DNA switches, and these switches tripped by epigenetic toxins can remain tripped into up to 5 generations hence, even if the original cause or toxin has been removed in the first generation. The implications for health and humanity for future generations considering epigenetics is mind blowing. Slides 28 - 32 tell the story of epigenetics and the impact on DNA expression, all the way to cancer.

### **Heavy metals also act as xenohormones and hormone disruptors in the living body.**

Our hormones are all stereoisomers, meaning atoms are arranged differently in 3 dimensional space, and are subject to the toxic effects of xenohormone environmental toxins. Heavy metals have been shown to act as xenohormones, entering into the cellular receptor sites and skewing the hormone biochemical pathways for Estrogen, Testosterone, Progesterone, Cortisol, Pregnenolone, Thyroid, DHEA, Insulin and more. Since hormones are key initiators, regulators and intermediary metabolites of virtually every biochemical reaction in the living body, the protection of their integrity is crucial for their actions. Heavy metals, environmental chemicals and industrial chemical wastes can act as "xenohormones", and interfere with natural hormones, enzymes, etc., and cause cancer and other severe ill health compromises.

Further, heavy metals are known to be "xenoestrogens", a hormone mimic of estrogen, the female and growth hormone. Estrogenic toxicity causes cancer, skin lesions, obesity, fertility problems, accelerated aging, liver problems, learning problems, mood disorders, metabolic syndrome, blood sugar irregularities, blood fat irregularities, increase in breast tissue and size in both males and females, smaller or even undeveloped male genitalia and higher anger and anxiety responses to daily life situations. Mineral imbalances caused by high levels of toxic heavy metals themselves, also are known to cause hormone imbalances of insulin, thyroid, testosterone, progesterone, estrogen and cortisol.

We see those very problems exemplified in the most toxic areas of the world, and in increasing statistics overall in the world, as environmental pollution moves around the world. All of the heavy metals studied so far, that are common exposures to man, have

shown to be “xenoestrogens”, including those that are generated from the rock strata at ISL mines. The increase in obesity of animals and humans over the last several decades is directly correlated to the increase of environmental toxins that are known to be fat soluble and deposited in body fat, including heavy metals.

Reference:

### **The Effects of Metals as Endocrine Disruptors.**

Iavicoli I1, Fontana L, Bergamaschi A., J Toxicol Environ Health B Crit Rev. 2009 Mar;12(3):206-23. doi: 10.1080/10937400902902062.  
<https://www.ncbi.nlm.nih.gov/pubmed/19466673>

### **Abstract**

“This review reports current knowledge regarding the roles that cadmium (Cd), mercury (Hg), arsenic (As), lead (Pb), manganese (Mn), and zinc (Zn) play as endocrine-disrupting chemicals (EDCs). The influence of these metals on the endocrine system, possible mechanisms of action, and consequent health effects were correlated between experimental animals and humans. Analysis of the studies prompted us to identify some critical issues related to this area and showed the need for more rigorous and innovative studies. (1) Study the possible additive, synergistic, or antagonistic effects on the endocrine system following exposure to a mixture of metals since there is a lack of these studies available, and in general or occupational environments, humans are simultaneously exposed to different classes of xenobiotics, including metals, but also to organic compounds that might also be EDCs; (2) assess the potential adverse effects on the endocrine system of low level exposures to metals, as most of the information currently available on EDCs originates from studies in which exposure levels

Our hormones are all stereoisomers, meaning atoms are arranged differently in 3 dimensional space, and are subject to the toxic effects of xenohormone environmental toxins. Heavy metals have been shown to act as xenohormones, entering into the were particularly high; and (4) assess the effects on the endocrine and reproductive systems of other metals that are present in the general and occupational environment that have not yet been evaluated.”

**Heavy metals are also known to denature protein and negate the biochemical activities of protein based enzymes and hormones, as well as cause effects in skeletal muscles.** Protein makes up a full 90% of the dry weight of the living body. Any

living body, any species. Protein is an organic compound composed of long chains of amino acids. Each protein has its own distinct combination of amino acids and also its unique three dimensional shape, and it is the shape that gives it its unique biochemical activity, not simply the chemical formula of its amino acid composition. **This is the most important concept in protein, hormone and enzyme biochemistry.**

Denaturation is a process in which proteins lose their three dimensional structure/shape which is present in their native state, causing them to unwind and deform, by application of some external stress or compound such as a strong acid or base, a concentrated inorganic salt, an organic solvent (e.g., alcohol or chloroform), radiation or heat. If proteins in a living cell are denatured, this results in disruption of cell activity and possibly cell death. Denatured proteins can exhibit a wide range of characteristics, from conformational change and loss of solubility to communal aggregation to form a solid.

### **Heavy Metal Salts:**

**Heavy metal inorganic salts act to denature proteins in much the same manner as acids and bases.** Heavy metal salts usually contain  $\text{Hg}^{+2}$ ,  $\text{Pb}^{+2}$ ,  $\text{Ag}^{+1}$ ,  $\text{Tl}^{+1}$ ,  $\text{Cd}^{+2}$  and other metals with high atomic weights. Since salts are ionic they disrupt salt bridges in proteins. The reaction of a heavy metal salt with a protein usually leads to an insoluble metal protein salt, meaning that it forms a solid and becomes inactive biochemically.

A common example that we all understand and that is epidemic in the human and pet animal population today, is that of insulin. Insulin is a three dimensional folded protein that acts also as a hormone, regulating blood sugar but escorting glucose in the blood into the tissues for storage. If the insulin cannot accomplish this process, then the blood sugar rises to dangerous levels and the patient is diagnosed with Diabetes.

Non-Insulin Dependent Diabetes, or Diabetes Type 2, is the result of such a compromise in the body, with the insulin not able to perform its designated function. It is also called Insulin Resistant Diabetes, because simply giving the affected patient more insulin does not cure the problem. Typical blood testing of insulin reveals the presence of adequate insulin or even higher than normal levels, but conventional blood testing is not capable of viewing the actual three dimensional shape of the molecules to properly assess their actions or lack of. So we typically see the Type 2 diabetic having both high blood glucose along with high insulin levels that are not working effectively. The insulin has been denatured in the blood, and any new insulin that would be still functional when administered to the type 2 diabetic with toxic blood sporting effective levels of some denaturing toxin, will just further deform any new and functional insulin given. Such is the naming of "Insulin Resistance".

The same scenario is commonly born out with thyroid testing and other natural hormones such as estrogen, testosterone, progesterone, DHEA, cortisol, pregnenolone, etc. We call this scenario in medicine “euthyroid hypothyroid” for thyroid, and appropriately such for the other hormones, where the blood levels show normal levels but the patient manifests hypo hormone symptoms, because the hormones present have been denatured and rendered ineffective. This is a serious problem for medicine today. This is a serious problem in assessing the real toxicity of any environmental toxin that has been shown to denature protein, such as heavy metals. Conventional blood testing does not accurately reflect the true health compromise of the sick individual. Slides 33 - 34 show how proteins are formed and then folded into their three dimensional shapes and then subsequently unravelled and deformed by denaturing agents. Slide 35 shows the hormone insulin with its characteristic folded nature, that is unfolded in Type 2 diabetes by denaturing agent exposure.

Metals cannot be broken down to other elements in Nature or the living body, and in fact, toxin exposure in continuous low levels, formerly thought to be safe, have now been shown to have additive or synergistic effects, where the end effects of a combination of toxin exposure produces more severe health compromises than those that would be expected from each toxin. The common example is that 2 +2 now equals 8. Since different chemical forms of minerals and metals can and do exist, and some are more toxic than others, and travel up the food chain at different rates. Different chemical forms of minerals and metals target different organs and tissues of the body.

Additionally, each individual toxin is shown to enter the body at levels under the body's detoxification radar of liver detoxification, thus allowing toxic levels of the pollutant to build up over time, until the body becomes so sickened that it cannot help itself anymore in a detox and elimination protective method.

Reference:

**Combined Toxic Exposures and Human Health: Biomarkers of Exposure and Effects**

Int. J. Environ. Res. Public Health 2011, 8, 629-647; doi:10.3390/ijerph8030629  
[www.mdpi.com/1660-4601/8/3/629](http://www.mdpi.com/1660-4601/8/3/629)

The moral of the story is that once you severely contaminate an aquifer and the environment with radiation and heavy metals, it cannot be taken back. The initial financial rewards enjoyed for a relatively short time become horribly costly in the end, much more so than the initial rewards. For this reason, ISL mining has been banned in Europe.

And science now understands that exposure of just one generation of individuals, will have their genetics impacted in a negative way for the next 5 generations, even if that

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individual is removed from the contamination. This is HUGELY significant! This means that birth defects from environmental toxins can last up to 5 generations afterward.

Contamination of our water, land and air with radiation and toxic chemicals released in uranium mining and processing cannot be taken back...not in our lifetime, nor the lifetimes of the next 5 generations. In fact, it cannot be taken back at all.

Civilization has been shaped over time by science and scientific discoveries. In- deed, this is how we grow and develop as humanity. New observations by man are incorporated into the standard paradigm which change our world views, and shape and direct our actions for the future. We learn from our mistakes, or are supposed to.

When new observations come into conflict with the standard paradigm, there is always outrage, resistance and denial, as the status quo is challenged. However, for man to progress forward, these new observations must be incorporated into our learning curve so that civilization can progress forward. We must keep learning about our environment, our surroundings and our place in it, to survive, maintain and improve our quality of life on Earth.

In decades past, we thought that butter was the best treatment for burns. In fact, even hospitals put butter on burns. It wasn't until an oil tanker burned and sank in the north Atlantic, leaving the crew with burns up to 80% of their bodies and float- ing in the cold ocean for 14 hours until help arrived, that we discovered that cold water was the superior treatment for burns. When the crew was plucked from the cold ocean water, they were in remarkable shape. This new discovery by tragedy, changed our paradigm of burn treatment forever. Yes, it caused the expected denial, resistance and outrage by the traditionalists, but further studies comparing different treatments of burns proved the new discovery correct, and a paradigm shift was accomplished.

Today, with ISL mining, we are now seeing the same traditionalist beliefs prevailing here, however history has shown us that ISL mining cannot be contained, aquifers cannot be restored to baseline, and the mining toxic wastes cannot be disposed of in a safe and economical way. So, we professionals here testifying for you today, from various fields of expertise, are giving you the latest research and information for you to use, for the opportunity for you to right a grave wrong, to upgrade our paradigm for the good. Understanding that those who came before you, permitted ISL technology with the belief that mining in a totally reduced zone, a condition that other areas exhibit, would safely secure any excursions, that they would just go out and hit the reduced zone and turn back into rock and be contained for safety. However, history has shown us otherwise. Now, with the experience of history and the research we have given you, you have the opportunity to upgrade our mining scientific paradigm and uphold your agency's commitment to guarding the environment and safety of the American people with your oversight, that is regulating agency mandate, and deny this permit.

## **Ex. 6 Personal Privacy (PP)**

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The Larimer County Environmental Advisory Board, February 12, 2008

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Choe SY1, Kim SJ, Kim HG, Lee JH, Choi Y, Lee H, Kim Y. Sci Total Environ. 2003 Aug 1;312(1-3):15-21.

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Bogdan Georgescu, Carmen Georgescu, Stelian Dărăban, Anca Bouaru, Simona Paș-calăuGeorgescu B. et. al./Scientific Papers: Animal Science and Biotechnologies, 2011, 44 (2)

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**Heavy Metals Acting as Endocrine Disrupters**

Cheryl A. Dyer, PHD

[eknygos.lsmuni.lt/springer/631/111-133.pdf](http://eknygos.lsmuni.lt/springer/631/111-133.pdf)

**5 Heavy Metals as Endocrine-Disrupting Chemicals**

[eknygos.lsmuni.lt/springer/631/111-133.pdf](http://eknygos.lsmuni.lt/springer/631/111-133.pdf)

**Selenium in a Wyoming Grassland Community Receiving Wastewater from an *In Situ* Uranium Mine.**

P. Ramirez, Jr., B. P. Rogers,

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Wah Chu K1, Chow KL. Aquat Toxi- col. 2002 Nov 13;61(1-2):53-64.  
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Sasadhar JanaMonojit A. Choudhuri. Water, Air, and Soil Pollution, January 1984, Volume 21, Issue 1-4, pp 351-357  
<https://eurekamag.com/pdf.php?pdf=001260236>

**Amino acid chelated compositions for delivery to specific biological tissue sites**

Patent number: 4863898 Filed: February 6, 1986Issued: September 5, 1989  
Assignee: Albion International, Inc. Inventors: Harvey H. Ashmead, H. Dewayne Ashmead, Darrell J. Graff  
[www.google.com/patents/US4863898](http://www.google.com/patents/US4863898)

***Our Stolen Future: Are We Threatening Our Fertility, Intelligence, and Survival?***

1996 Theo Colborn, Dianne Dumanoski, and John Peterson Myers  
[www.ourstolenfuture.org/](http://www.ourstolenfuture.org/)

## **Combined Toxic Exposures and Human Health: Biomarkers of Exposure and Effects**

Int. J. Environ. Res. Public Health 2011, 8, 629-647; doi:10.3390/ijerph8030629  
<https://www.ncbi.nlm.nih.gov> > NCBI > Literature > PubMed Central (PMC)

### **Epigenetics and gene expression**

<http://www.diabetesandenvironment.org/home/mech/genes>

### **Verbal Testimony to EPA on Dewey Burdock UIC Class 3 mining and Class 5 disposal wells oral presentation at hearing:**

My name is Linsey McLean, and I am an environmental biochemist in toxicology for the last 40 years. I was born and raised in Flint, Michigan, lived there for the first 55 years of my life with over 450 Class 7 industrial dumpsites in each of the counties in SW Michigan. So I am well acquainted with environmental contamination of all kinds. This is the reason, actually, that I sought my course of study, and pursued a career in the effects of environmental pollution on the living body of both humans and animals. I am also a federally approved expert witness.

I am submitting testimony on why it is necessary to include uranium in the metals testing for MCL/maximum contaminant levels.

Currently, uranium is not one of the monitored metals in wastewater for uranium mining sites and should be. Even if the other metals are under the MCL's, uranium can be nearly off the chart and has been found to be so in old ISL sites that are attempting restoration. This has already been shown for several mines in Wyoming and Nebraska. Dewey Burdock waste injection wells will be sending plumes into the Minnelusa water as it flows south and east, through Igloo- the Black Hills Army Depot, through Buffalo Gap, Oelrichs, and elsewhere, and on into the Indian reservations that are already suffering contamination from the old open pits near Edgemont, SD.

Metals can bond with many different molecules, which can then become completely different compounds, with totally different chemical and biochemical "personalities" and activities. If they bond with inorganic substances such as phosphate, oxide, sulfate, carbonate etc, they will form inorganic compounds. However, if they bond with carbon containing compounds, they become "organified" and will then have different toxicities and different biochemical activity in a living body. Organified metals have a significantly higher bioavailability in the living body, and much more ability to travel to, and target,

different organs and tissues of the body, interfering at the highest rate with normal healthy biochemical pathways than inorganic metals. “Organic” metals, are the substances of life itself.

High levels of organified uranium have been studied and measured by the DOE recently, in old uranium mines. How did it get there when they are supposed to be extracting the uranium?

Organified metals, including uranium, are known **not** to be recoverable by the ion exchange method of ISL recovery, since it is already bound organically and will not bind to the organic synthetic resins. So the levels will build up as the mining waters are recycled over and over in the ISL mining process, until the waters become too saturated and are disposed as waste. Organically bound metals under this circumstance, will continue to increase in the waste water of the ISL mine, **adding to the metal burden of the wastewater, and also the toxicity of such, beyond what it would be if the metals remained in an inorganic and ionic form. There should be very elevated levels of organified uranium and other metals in the Inyan Kara, because of the contamination of the aquifer with micro organisms from open boreholes and decaying fenceposts placed in the old boreholes, so little recoverable uranium is there. There should be minimum levels of actual mining uranium shown for the permit, spectated and inorganic.**

Organic forms of any heavy metal are able to penetrate the lining of the digestive tract much easier than ionic and inorganic salts, that are blocked by their electrical charges. Organic metals act as a “chelate”, something that the health industry does to essential minerals to significantly improve absorption, and also make them much more able to enter into direct biochemical reactions in the living body.

Selenium, another metal, known to have wonderful health effects, preventing cancer, and enhancing thyroid hormone. But inorganic selenium, the form generated in ISL mining, is known to cause birth defects of the highest severity. Higher evolved animals above micro organisms are not able to convert quantities of the inorganic forms of minerals, even essential ones like selenium, into the biocompatible organic forms. Plants and micro organisms do that in rivers and soils, and can make heavy toxic metals even more toxic as they organify them.

The incongruencies between actual toxicities of some chemical forms of metals and the regulatory levels is huge. Most toxicity level charts fail to take into consideration the chemical forms of metals, which is absolutely critical in assessing any toxicity status, and currently are not being tested for.

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My recommendation to EPA is to upgrade their testing of MCL's by including the speciation of inorganic forms of metals, and testing for organified forms, including uranium. Then, comparing the LD 50 levels of each chemical form, which are often orders of magnitude in difference. Only then can the true toxicity of the wastewater you are testing be assessed. Using only a quantitative analysis of the metals tells you nothing about the toxicity you are actually looking for.

The history of the Dewey Burdock area as far back as the 1950's is well known. But what is not well known is the summary of the explorations and subsequent 7,650 old boreholes left by the TVA unclosed or improperly closed, in two different explorations, over 10 years, which says: "The aquifer test results indicate that the Fuson member of the Lakota formation is a leaky aquitard separating the Fall River and Lakota aquifers. The hydraulic communication between the two aquifers observed during the tests is believed to be the result of (1) general leakage through the primary pore space and naturally occurring joints and fractures of the Fuson shale, and (2) direct connection of aquifers via numerous old unplugged exploratory boreholes." Thus, the ability to dewater the area for mining was impossible and the site was abandoned...twice. The understanding was that even if the boreholes were closed, there are still enough geologic anomalies to prevent effective confinement of rock layers for ISL mining, or dewatering for tunnel mining. Powertech knew about this when they first concocted this business, but failed to disclose to NRC and EPA and the public. In fact, the permit papers filed to the state of SD featuring tested uranium concentrations in the area, show the highest levels in the alluvial aquifers, which are essentially runoff from the old roll front that was completely mined out back in the 1950's and 60's in the open pit mines left there, and are not able to be mined due to lack of confinement. There is essentially no economically recoverable uranium left in that area to mine, and why the TVA abandoned the site...twice. The roll front is gone, mined out.

As stated by others, the business model of Powertech is not actually uranium mining. But by their own admission, they lack funds to mine and even fulfill the requirements of the NRC before they can mine, of closing those old boreholes. While a normally profitable mining venture is situated atop a concentrated uranium source roll front, Dewey Burdock's roll front is gone, as was documented by TVA. Additionally, there are extra costs of preparation of the site that are huge, even before mining could begin, that other regular sites do not have. They have to find and properly close all of the 7,650 old boreholes and do new pump tests to show proper confinement, which by expert assessment would take 3 years or so. Other mine sites do not have this. And, since the state of SD does not permit Class 1 disposal wells, which do not require prior treatment of hazardous wastes, Powertech will have to treat their wastes before deposition, another additional cost of production. With their testified break even cost of production at \$63.00 per pound of yellowcake, without those extra production costs that other mines do not have, and the future of yellowcake predicted to fall even more from the

current spot price of just \$16.00 per pound, since long term contracts are difficult to obtain now with the world in excess supplies, the business model would not reasonably include actual uranium mining.

So the business of hazardous waste deposition becomes the only way to make money, and likely why the original ridiculous request of 8 hazardous waste injection wells was done. Normally, mines like this only need one. So still the request for 4 Class 5 wells is still ridiculous, and without the ability or clear permit to mine. And they say they need two right away? What in the world for?

The ability to purify the wastewater to class 5 standards is not considered. Simply putting the waste waster in a pond to air out the radon gas and then precipitating out the radium with barium chloride does NOT remove the other radioactive and toxic components. The toxic metals that have been mobilized are still there, and that includes vanadium, strontium, thallium, thorium, some radioactive forms of lead, and organified uranium that has been documented to build up in the recycled wastewater, and is not recoverable by ion exchange, and are all radioactive as well as toxic as heavy metals. This does NOT constitute the level of safety equal to “stormwater” or “sewage effluent” that a Class 5 well is limited to. If Powertech were able to clean this water to levels they boasted about in the NRC/ASLB hearing “so pure you could almost swim in it”, then that water would be most valuable for agriculture, irrigation and farm use in this high dry area of the country. It does not meet the qualifications for a Class 5 UIC, not for the concentration of toxic metals, or radioactivity of such.

There are usable Minnelusa wells in the southern Black Hills, down gradient from Dewey Burdock. The state DENR says they know of thousands of current Minnelusa wells under use there, however there are many other older wells not registered by the state, where the owners do not even know what aquifer they are in, or how deep their wells are. They will not know when they are sucking up hazardous radioactive heavy metals until they get cancer and their cattle die. Then comes the class action law suits to both EPA and Powertech, (who will undoubtedly bail and file bankruptcy and walk away from the mess, leaving EPA holding the bag) because you were informed of these private wells before these permits were even issued, and did it anyway. If these permits are issued, the Council For Responsible Mining will begin getting baseline testing and monitoring of these wells for class action lawsuits that will surely follow as the plumes flow, south and east, through Igloo and beyond.

### **Which brings me to the the subject of Igloo...**

The proximity of Igloo, the 367,000 tons of various nerve gasses known to be unstable in old metal containers, that are self igniting and both water soluble and oil soluble, buried in over 200 miles of both naturally occurring and man made tunnels, presents a

unique hazard of epic proportions on the planet, if flooded by highly oxidative lixivients or disturbed by seismic activity known to be caused by injection wells. This alone should negate the Dewey Burdock site for any and all mining activity.

Reclamation of the affected land and aquifers are not physically or economically feasible, as has been demonstrated in these mines all over the world. Heavy metals, most notably: Selenium, Molybdenum and Arsenic, in addition to the radioactive metals listed prior, will be generated in soluble forms that are highly toxic to all living things, and are able to be concentrated even further by bioaccumulation up the food chain, which brings me to the last points, that of current regulations and proper and effective oversight.

## Regulations

IUC wells are required to treat wastes to acceptable levels of toxicity **or prove there is no mitigation of the waste.**

The wells are designed so that if they happen to fail, the waste would be confined to the injection zone. **No mitigation means the waste will not affect an underground water supply for 10,000 years or until the waste is not harmful. To ensure this, the EPA mandates there are no faults or other adverse geological features present in the area, that the well injects into layers that do not currently hold water but have the correct features (porosity and permeability), and that are below a confining layer.** In no way does the Dewey Burdock site comply with these regulations. **In this case, the metals are quite immortal. They do not break down and do not detoxify.**

## Lack of oversight of UIC wells

**I quote a report that criticizes EPA oversight of injection wells from ProPublica published in 2014:**

The Government Accountability Office says environmental regulators are failing to adequately enforce rules for wells used to dispose of toxic waste from drilling.

*by Naveena Sadasivam*

*ProPublica, July 29, 2014, 3:40 p.m.*

**It goes on to say, “injection wells used to dispose of the nation’s most toxic waste are showing increasing signs of stress as regulatory oversight falls short and scientific assumptions prove flawed.”**



“Federal environment officials have failed to adequately oversee hundreds of thousands of wells used to inject toxic oil and gas drilling waste deep underground, according to [a new congressional report](#).”

“The report, by the U.S. Government Accountability Office, is critical of the Environmental Protection Agency's inconsistent handling of safety inspections, poor record keeping, and failure to adjust its guidelines to adapt to new risks brought by the recent boom in domestic drilling, including the understanding that injection wells are causing earthquakes.”

“The GAO's findings echo those in [a 2012 ProPublica investigation](#) which found that the nation's injection wells were often poorly regulated and experienced high rates of failure, likely leading to pollution of underground water supplies. ProPublica's investigation found that the EPA did not know exactly how many wells existed in the United States or what volume of waste was being injected into them, and that it did not possess complete records required to be collected under the Safe Drinking Water Act.”

“These wastes, often euphemistically referred to as "saltwater," commonly contain a mixture of water, hazardous chemicals and radioactive minerals.”

“The EPA generally agreed with the GAO's findings and characterization of the challenges the agency is currently facing. Concerns have mounted recently about potential water contamination from injections wells.”

This report was done when EPA had a fuller staff and budget. What upgrades to inspections and oversight have been made since 2012? And how will new budget cuts under the Trump administration affect oversight and regulation of injection wells? If EPA depends on permit fees from industry to make up a significant portion of their budget, as FDA and NRC do, 95% to be exact, then how can we be sure that EPA does not just issue, in this case, permits in dangerous areas that should not be issued, just because they have to underwrite their paychecks? **If the circumstances of the past have not been rectified, then no new permits for any injection wells should be issued, period.**

Citing:

### **Water Contamination, 2008-2010**

Cases of Unauthorized Injection, of toxins not permitted = 859

Cases of Over Pressurized Injection, resulting in damage to well casings and equipment = 1,199

Test Failures for Significant Leaks = 6,723

**Total Wells With Violations = 60,467**

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## **In Conclusion**

No ISL mines have ever have proven to be safe and free of excursions, or been able to be properly decommissioned with the mined aquifer restored to baseline chemistry levels, so that the water is drinkable and safely usable. The high dry area we live in cannot afford this sacrifice. ISL mining has been banned in other countries for that reason.

Humanity has continuously failed to clean up our mining messes throughout history, as evident from all the superfund sites of total and complete loss of any use all over the country and the world, not to mention the over 10,000 other old uranium mines that should be super funds and are not, due to lack of funding for remediation/burial. If ever there was a case for your first rejection of a permit, it is most certainly, here and now. Oh, and I have a Minnelusa well.